THE METABOLISM OF THE SOYBEAN PLANT

BY
FRANK MILTON STUBBLEFIELD
A.B., University of Illinois, 1932
M.S., University of Illinois, 1936

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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THE METABOLISM OF THE SOYBEAN PLANT

Chemical analyses and yields of stems, leaves, pods, and seeds of fertilized and unfertilized Chief soybeans are reported. The samples for analyses were taken weekly throughout the growing season, beginning one week after emergence of the seedlings and ending at the time of harvest of the mature seeds.

Vegetative growth of the plants increased rapidly until the tenth bloom stage, which was the sixth week of growth, when a marked decrease in rate of growth of leaf and stem occurred. This period of slow growth lasted for a week, and coincided with the change from the stage of growth which was primarily vegetative to that which was primarily reproductive. Subsequently, the weight of the plant increased markedly. The increase in weight during the first nine weeks was due to vegetative growth of the stem and leaf, while the formation of pods and seeds was responsible for the increase in weight during the remainder of the growing period.

Soil fertilization increased the weight of soybean plants, although the effect of fertilizers was not apparent until after seed formation started. The plants receiving fertilizer containing phosphorus and potassium were heavier than those receiving phosphorus alone.

The fertilizers had a greater effect on seed production than on vegetative growth, the 0-20-0 and 0-20-20 fertilizers increasing the yield by four and five bushels per acre respectively.

The soybeans on the plot receiving superphosphate matured a week earlier than those on the untreated land, and the soybeans on the plot fertilized with both phosphate and potash matured a few days later than on the untreated plot. These observations are in accord with results secured by other workers showing that phosphorus tends to hasten and potassium to delay maturity.

Chemical analyses showed that nitrogen, phosphorus and

potassium were present in largest concentrations in the young tissue of the stem, leaf, pod, and seed. With age, these percentages decreased; however these lower percentages were followed by an increase in concentration of these elements in the seed as maturity approached. The calcium percentage was low in the stem and leaf at the end of the first week after emergence, increasing during the following week; while the percentage was high in the tissue of the young pods and seeds. Calcium percentages increased with age in the leaf and pod, but declined in the stem and seed.

Nitrogen and phosphorus from the cotyledons supplied almost entirely the demands of the plant during the first week after emergence. Potassium was translocated less rapidly from the cotyledons and the plant absorbed a considerable amount from the soil in its first week after emergence. Calcium was moved from the cotyledons only slightly, and the plant was dependent upon the calcium from the soil to meet the demands of growth.

Nitrogen and calcium percentages were highest in plants from the plot receiving superphosphate fertilizer, while potassium percentages were highest in plants receiving the 0-20--20 fertilizer. Phosphorus percentages were affected little by fertilization.

Adolescence in the plant between the fourth and eighth weeks was marked by irregularities in the nitrogen percentages of the plant and plant parts.

In the final weeks before harvest, the stem and pod acted as a channel for translocation of nutrients to the seed. The leaf lost half its nitrogen to the seed before falling from the plant.

Nutrient intake may be divided into three periods. The first and third periods, which extended from the first to the sixth week and from the ninth week to maturity, respectively, were characterized by a rapid influx of nutrient elements to the plants. The middle period, lasting from the sixth week through the ninth week and covering the transition from the primarily vegetative stage to the primarily reproductive stage, was a period of decreased absorption.

Fertilizers applied to the soil had a marked influence upon the composition of the soybean plants during the early stages of their development, but had little or no effect upon the composition of the mature seed.

Profitable avenues of research are indicated. Fractionation studies of nitrogen and phosphorus compounds in the plant between germination and the fall of the cotyledons, and at the tenth bloom period, taking samples at three day intervals, would throw further light on the metabolism of the soybean.

VITA

The author was born June 25, 1911, at Hillsboro, Illinois. He was graduated from the Hillsboro Community High School in 1928 as salutatorian of his class. He entered Illinois College, Jacksonville, and, at the conclusion of his sophomore year, was awarded Preliminary Honors for high scholastic standing. In the fall of 1930, he enrolled at the University of Illinois, and received the degree of Bachelor of Arts with a major in chemistry in June, 1932. In June, 1936, he received the degree of Master of Science in chemistry.

He was employed as a chemist for two years by Swift and Co., and for four years by the University of Illinois, Department of Agronomy.

The author is a member of Sigma Xi, Gamma Sigma Delta, Tau Kappa Epsilon, and Phi Alpha. His publications are:

G. F. Smith, F. M. Stubblefield, and E. B. Middleton. Occlusion of Water by Potassium and Sodium Chlorides. Ind. Eng. Chem. Anal. Ed. **6**, 314. 1934.

F. M. Stubblefield and E. E. DeTurk. Effect of Ferric Sulfate in Shortening Kjeldahl Digestion. Ind. Eng. Chem. Anal. Ed. **12**, 396-9. 1940.

F. M. Stubblefield and E. E. DeTurk. The Composition of Corn, Oats, and Wheat as Influenced by Soil, Soil Treatment, Seasonal Conditions, and Growth. Soil Sci. Soc. Amer. Proc. 1940, **5**, 120-4.

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